# Alergia pokarmowa – epidemia XXI-ego wieku?

**MD**
**Anna Nowak-Węgrzyn**

Elliot and Roslyn Jaffe Food Allergy Institute, Division of Pediatric Allergy, Mount Sinai School of Medicine
New York, USA

D I A G N O S T Y K A

## Food allergy: epidemics of the 21st century?

S U M M A R Y

**Food allergy is an adverse reaction to food that is caused by a specific immune response. Food allergy is a common disorder, with studies suggesting a cumulative prevalence of 3% to 6%, representing a significant impact on quality of life and costs. The inclusion of mild reactions to fruits and vegetables could result in calculation of prevalence exceeding 10% in some regions. Prevalence varies by age, geographic location, and possibly race/ethnicity. There are data to suggest that the prevalence of food allergy has been increasing over the past two decades.**

**Alergia pokarmowa jest reakcją organizmu na białka pokarmowe o podłożu immunologicznym. Alergia pokarmowa jest częstym schorzeniem, które dotyka około 3%-6% populacji krajów wysoko-rozwiniętych, wiąże się ze znacznymi kosztami i ma negatywny wpływ na jakość życia. Występowanie alergii pokarmowej jest częstsze u dzieci i jest uwarunkowane położeniem geograficznym oraz pochodzeniem etnicznym. Najnowsze badania wykazują, że występowanie alergii pokarmowej zwiększyło się na przestrzeni ostatniego dwudziestolecia.**

Nowak-Węgrzyn A.: Alergia pokarmowa: epidemia XXI-ego wieku?. Alergia, 2011, 3: 9-13

# Introduction

Food allergy is defined as “an adverse health effect arising from a specific immune response that occurs reproducibly on exposure to a given food.” (1)

The most common food allergens in children include cow’s milk, hen’s egg white, soy, wheat, peanut, tree nuts, and fish. In the adults the most common food allergens include: peanut, tree nuts, fish, and shellfish. In addition, mild oral symptoms (so called pollen-food allergy syndrome or oral allergy syndrome) caused by raw fruits and vegetables occur in a large subset (25-75%) of children and adults with pollen allergy. The manifestations of food allergy are diverse and range from mild hives to anaphylaxis and chronic gastrointestinal symptoms (reviewed in Table 1). (2)

Food allergy is estimated to affect “more than 1-2% but less than 10%” of the general population in the USA. (3) The wide estimate of the affected population reflects the challenges of determining food allergy prevalence with certainty due to the limited accuracy of the self-reported symptoms and the diagnostic allergy tests that rely on the

detection of the IgE sensitization to the specific foods. The gold standard of food allergy diagnosis, the double-blind, placebo-controlled oral food challenge (DBPCFC) cannot be easily applied to epidemiologic studies due to limited availability and high cost. (4) The issue is further complicated by the non-IgE-mediated food allergic reactions (also referred to as food hypersensitivity reactions) that are usually manifesting with isolated and chronic/intermitted gastrointestinal symptoms. These non-IgE-mediated food allergies usually occur in the setting of an undetectable food-specific IgE antibody (by serum measurement or prick skin test) and their diagnosis requires a confirmatory endoscopy and intestinal biopsy as well as empiric elimination diet and re-challenge with the offending food. Nevertheless, the literature on epidemiology of food allergy has been steadily growing over the past two decades and has accumulated robust evidence regarding the scope of this problem.

Food allergy has emerged as a major public health problem in the westernized societies in the past two decades. In the US, a recent study from the Centers for Disease Control reported an 18% increase in food allergy prevalence from 1997 to 2008 in children under 18 years of age. (5) In the US, Canada, and UK, prevalence of peanut allergy in young children tripled over the same time period. (6) Food allergy is the leading cause of anaphylaxis and the emergency department admissions for allergic reactions, over the past two decades there was an increase in the emergency department visits due to food allergy. (7)

## Public perception and common misconceptions about food allergy

Ingestion of foods can induce a number of adverse reactions (reviewed in the table 2). Patients may casually refer to any adverse food reaction as “food allergy”; up to 20% of the interviewed subjects report some “food allergy”. (8) However, only a fraction of those perceived adverse reactions has an immunologic etiology and the reported symptoms alone don’t provide a reliable estimate of food allergy frequency. The new US guidelines summarize a self-report rate of about 13% compared with about 3% when testing and or DBPCFC is performed. (1) The pediatric study by Bock (9) found 28% reported symptoms (parent or doctor reports), but only 28% of those with complaints were verified on OFC. In the study by Young et al, (8) 19% of the complaints were verified on challenges. It is important to discern the different pathophysiology of adverse food reactions because over-diagnosis of food allergy may result in global malnutrition or specific nutrient deficiencies.

## Prevalence of food allergy in the USA

In the US, the seminal population-based study was conducted by S. Allan Bock. (9) and estimated the prevalence of adverse reactions to foods in children under age 3 years to be between 6% and 8%. This study included children from a birth cohort, utilized frequent telephone contact with the parents and the pediatricians and supervised oral food challenges (OFCs). This study did not distinguish between immediate (classic, IgE-mediated) and non-IgE-mediated gastrointestinal food allergies. Liu et al (10) took advantage of the serologic testing (IgE to milk, egg, peanut, and shrimp) performed during the National Health and Nutrition Examination Survey (NHANES) in the United States from 2005 to 2006. Estimates of clinical food allergy risk were based on previous studies correlating clinical outcomes to food-specific IgE concentrations. (11) The overall food allergy prevalence was estimated at 2.5%. In the children age 1 to 5 years, clinical allergies to milk, egg, and peanut were estimated at 1.8% each. Branum and Lukacs (5) reported that in 2007, on the basis of the National Health Interview Survey response to the query, “During the past 12 months has [child] had any kind of food or digestive

allergy?", 3.9% of US children were affected and that the prevalence of food allergy increased by 18% between 1997-2007. Analyses of data from 2441 mothers in the 2005/2007 US Infant Feeding Practices Study II,(12) which followed newborns to age 1 year and defined probable food allergy as doctor-diagnosed or immediate food-related symptoms (likely urticaria/angioedema), found a rate of 6% (milk, 3.8%; soy, 1.4%; fruit, 1.2%; peanut, 0.6%; wheat, 0.5%).

In telephone surveys, shellfish allergy was reported at a significantly higher rate among black/African American subjects than white subjects (3.1% vs 1.8%). (13) Non-Hispanic blacks also had increased risks of having serologic results indicating likely food allergy in the NHANES study (odds ratio, 3.1). (14) Boys appear to be at higher risk than girls, and perhaps women more than men. (13)

**TABLE 1** Classification of food allergy based on the involvement of IgE antibody in the pathophysiology of food allergy

| Mechanism | IgE-mediated | Mixed* | Cell-mediated |
|---|---|---|---|
| General | Anaphylaxis; FDEIA ** | | |
| Gastrointestinal | Immediate GI symptoms<br>Pollen food allergy syndrome | Eosinophilic esophagitis /<br>gastroenteritis | Celiac disease; Enteropathy<br>FPIES***<br>Allergic proctocolitis |
| Respiratory | Bronchospasm | Asthma | Heiner's syndrome**** |

*Mixed pathophysiolgy involves both cell-mediated and IgE-mediated mechanism
**FDEIA: Food-dependent, exercise-induced anaphylaxis
***FPIES; food protein-induced enterocolitis syndrome
****Heiner's syndrome: pulmonary hemosiderosis reported in association with milk and buckwheat allergy

# Prevalence of food allergy in the UK and Western Europe

The prevalence of food allergy in the general population was estimated as 1% to 2% on the basis of a study by Young et al. (8) Venter et al (15) reported on the rate of food allergies among a birth cohort of 969 children on the Isle of Wight, UK, evaluated at age 3 years. Percent testing positive among 642 tested were as follows: peanut (2%), egg (1.4%), sesame (1.4%), wheat (1.3%), milk (0.5%), and cod (0.5%). The cumulative percentage of complaints of adverse food reactions was 34% at 3 years, with 8% having a current complaint. Using unmasked OFCs and a clear history, the cumulative incidence was 6%, and using DBPCFCs, 5%; the primary triggers were milk, egg, and peanut.

Osterballe et al (16) evaluated 1272 young adults age 22 years in Denmark, by using questionnaires, skin prick tests (SPTs), and OFCs. By questionnaire, 20% reported adverse reactions to non–pollen-associated foods, which after OFC (performed in 42 cases among 165 with complaints) resulted in a prevalence of 1.7%.

In the European Community Respiratory Health Survey, in which 4522 young adults from 13 countries were tested with up to 24 foods,(17) the most common food sensitizations included: hazelnut, peach, shrimp, wheat, apple, sesame, carrot, kiwi, celery, corn, tomato, rice, and buckwheat (from 7.2% to 2.8%), peanut (2.6%); banana, walnut, sunflower, soy, poppy, melon, mustard, milk, egg, and fish (from 2.5% to 0.2%).

# Pollen-food allergy syndrome

Among pollen-allergic individuals, 74% reported symptoms (majority had oral symptoms), to the pollen-associated foods (e.g., fruits and vegetables). (16) In a study of a birth cohort of 562 children from Denmark (18) evaluated periodically with interviews, SPT, food-specific IgE, and OFC (offered for suspicion of allergy or positive tests without ingestion) to age 6 years, overall, 3.7% had positive food challenges to 1 or more foods.

Oral allergy syndrome/pollen food-related allergy clearly fulfills the definition of food allergy but is often not focused on when statistics are offered regarding food allergy. In a study of young adults in Denmark, 16.7% reported this type of allergy.(16)

# Prevalence of nut, sesame and shellfish allergy

A number of large population-based studies have addressed the prevalence of peanut and other food allergies. (19) (Table 3) Three studies used a random calling method with administration of a survey, two studies utilized allergy testing and OFCs, and one was a retrospective study in a specialist referral population. (6;20-22) All of these studies estimated that peanut allergy affects more than 1% of children in Canada, the United States, Australia, and the UK.

**TABLE 2** Differential diagnosis of food allergy: selected non-immune mediated adverse food reactions

| Toxic / Pharmacologic | Non-Toxic/ Intolerance |
|---|---|
| | Latose intolerance due to lactase deficiency |
| | Galactosemia |
| Food poisoning | Pancreatic insufficiency |
| Scromboid fish poisoning | Gallbladder / liver disease |
| Histamine | Panic, anxiety |
| Tyramine | Depression, anorexia, bulimia |
| Caffeine | Hiatal hernia |
| Alcohol | Gustatory rhinitis |
| | Auriculotemporal syndrome* |
| | Blepharochalasis** |

*Auriculotemporal syndrome (Frey's syndrome): transient uni or bilateral facial flushing or sweating following ingestion of spicy or flavored foods,

infants and children with history of forceps delivery and damage to auriculotemporal nerve.

** Blepharochalasis an inflammation of the eyelid that is characterized by exacerbations and remissions of eyelid edema, which results in a stretching
and subsequent atrophy of the eyelid tissue resulting in redundant folds over the lid margins. It typically affects only the upper eyelids,
and may be unilateral as well as bilateral.

# Meta-analyses and large scale reviews

A systematic review of the world literature by RAND Corp was performed by using pre-specified criteria and conluded that food allergy affected from 1% to 2% up to 10% of the population. (3) Two large meta-analyses were published by the EuroPrevall program. (23) (24). These meta-analyses showed significant heterogeneity between studies regardless of food item or age group. The EuroPrevall working group searched MEDLINE and EMBASE for articles from 1990 to 2005 and identified 51 articles that fulfilled inclusion criteria out of the 934 articles initially identified from a wide search strategy. Considering studies of allergy to “any food” where multiple foods were assessed, the overall prevalence rates were 12% self-reported in children and 13% in adults (based on 23 studies), 3% for all ages on the basis of testing and history (6 studies), and 3% for all ages on the basis of studies that included DBPCFC (6 studies). The studies had marked heterogeneity: rates of self-reported allergy varied from 3% to 35%. The rates of self-report, symptoms with sensitization, and rates based on OFC were as follows, respectively: peanut (0.75%, 0.75%, not available), milk (3.5%, 0.6%, 0.9%), egg (1%, 0.9%, 0.3%), fish (0.6%, 0.2%, 0.3%), and shellfish (1.1%, 0.6%, not available). Higher prevalence among children was seen; for example, 6% to 7% children self-reported milk allergy compared with 1% to 2% adults. Zuidmeer et al (24) reviewed the prevalence of plant food allergies to fruits, vegetables, legumes, tree nuts, wheat, cereals, soy, and seeds. Among the 6 studies including OFC, prevalence ranged from 0.1% to 4.3% each for fruits and tree nuts, 0.1% to 1.4% for vegetables, and <1% each for wheat, soy, and sesame. The prevalence of reported symptomps exceeded prevalence of sensitization except for wheat and soy among adults.

# Food allergy and other allergic disorders

Food allergy is associated with other allergic disorders, including atopic dermatitis and asthma in childhood, anaphylaxis, and eosinophilic esophagitis, reviewed in table 4.

# Is food allergy increasing in prevalence?

There are several studies in which similar methods where applied over time, that showed a 2-3-fold increase in peanut allergy and peanut-IgE sensitization in children in the US, UK, Canada, and Australia over the past 10-20 years. Multiple studies show rates of peanut allergy over 1% in young children.

In a study from the same clinic in China performed in 1999 and 2009, rates increased from 3.5% to 7.7%
(P = .017). (25) Branum and Lukacs reported on several US national databases in which information could be compared over time. (5) Based on the response to, “During the past 12 months has [child] had any kind of food or digestive allergy?” there was an 18% increase from 1997 to 2007. On the basis of diagnostic coding in US national ambulatory care surveys, ambulatory care visits tripled between 1993 and 2006 (P < .01).

Eosinophilc esophagitis (EoE) is an inflammatory disease of the esophagus characterized by eosinophilic infiltration of the esophageal mucosa. (26) Symptoms of EoE include gastroesophageal reflux, abdominal pain, growth failure, and dysphagia. Dysphagia is a more common presentation in adults and older children. Esophageal food impactions necessitating urgent endoscopic removal of the food and esophageal strictures requiring endoscopic balloon dilatations may complicate EoE. The incidence of EoE (defined as minimum of 24 distal esophageal eosinophils per high power field (HPF), epithelial basal zone hyperplasia, and absence of eosinophilia in any other gastrointestinal segment) increased from 9.1 cases/100,000 children in 2000 to 12.8 cases per 100,000 in 2003, and the prevalence has increased from 9.9 per 100,000 in 2000 to 43 per 100,000 in 2003.(27) Similar trends have been observed in adults with EoE residing in Olten County, Switzerland . (28;29) Criteria for the diagnosis of EE consisted of typical history, typical endoscopic abnormalities, and histologic infiltration of the esophageal epithelium by 24 or more eosinophils per HPF, after excluding gastroesophageal reflux disease clinically and endoscopically. Annual incidence of 1.7 cases per 100,000 inhabitants was noted (range 0–8), with a marked increase in newly diagnosed cases in the past few years. EoE is a chronic disease and the prevalence steadily increased from 2 per 100,000 in 1989 to 30 per 100,000 at the present time.

**TABLE 3** Prevalence of allergy to specific foods

| Food | General | Children <5 years of age | Adults |
|---|---|---|---|
| Cow’s milk | 0.4% - 0.9% (14;23) | 0.5%* (Israel)(52) -3.8% (US, UK)(12) (15) (14) | |
| Hen’s egg white | 0.2%(14) | ~2% (14) (15) | |
| Soybean | 0;0.7% (24) | 1.4% | 0 - 0.7%*(24) |
| Wheat | 0;1.2% (24) | ~0.5%(12) (15) | 0-1.2% (24) |
| Peanut | 0.75%(23)- 1.3% (14) | 0.2% (Israel)(53) -1.9 % (US, Canada, UK) (20); (6;53); | 0.7% (6;20) |
| Tree nuts* | 0.6%-1.1% (6;20) | 1.1% (6); 1.6% (20) | 0.5%(6); 1% (20) |
| Sesame/seeds | Overall, 0.1%(20) (6); <1%* (24) | 0.6%(15) | |
| Fish | Overall, 0.3%; 0.5% (23) (20)<br>(6) | 0.2%(20) (6); 0.5%(15) | ~ 0.6%(20); (6) |

| | | | |
|---|---|---|---|
| Shellfish | 0.6%(23); 2%(14); (6;20) | 0.5% (20) (6)<br><br>Age 14-16 y, 5.2% (Singapore)(22) | 1.7%(20); 2.5% (6) |
| Fruits | up to 4.2% (SPT); up to 8.5% (symptoms)(24) | 0.4%* (UK)(15) | |
| Vegetables | 0.1 to 0.3%*, up to 2.7% (SPT); up to 13.7% (symptoms)(24) | 1.2% (12) | |
| Oral allergy (raw fruits/vegetables) | | | Age 22 y, 17% (Denmark) (16) |

# Food-induced anaphylaxis

Food is the most common trigger of anaphylaxis in the community.(30) In the United States, comparison in Minnesota from 1983 to 1987 and 1993 to 1997 potentially show a 71% to 100% increase.(30-32) Studies focusing on pediatric food-related ambulatory and emergency department visits or food-induced anaphylaxis suggest increases as well. (5;33;34) Data from 34 emergency departments in the US National Electronic Injury Surveillance System were analyzed for food-related adverse events over August and September 2003. (34) There were 20,281 emergency department visits, 2333 episodes of anaphylaxis, and 520 hospitalizations for food allergy reactions in the United States over this 2-month period. For adults, shellfish was the most common trigger, whereas egg, fruits, peanuts, and tree nuts were more common triggers for young children. In 117 pediatric patients presenting with anaphylaxis to 1 hospital in Melbourne, Australia, food was responsible for 85% of reactions, and peanut (18%), cashew (13%), and milk (11%) were the most common triggers. (35) Two US emergency department–based cohort studies and the US National Hospital Ambulatory Medical Care Survey estimated 203,000 emergency department visits per year (for 2001-2005; 38% pediatric), including 90,000 as probable anaphylaxis. (36)

There are no studies to address directly the prevalence of fatal food-allergic reactions. However, the series of cases of fatal anaphylaxis identified the important risk features including age (adolescents and young adults), delayed use of epinephrine, and co-morbid asthma. (31) (37;38) (35) (39)

# Risk factors

Epidemiologic risk factors for food allergy may include genetic risks (familial associations, HLA, and specific genes), association with atopy (eg, atopic dermatitis), timing of exposure to allergen, route of exposure (eg, topical/respiratory exposure may be sensitizing), reduced consumption of ω-3 polyunsaturated fatty acids, and the hygiene hypothesis. (40) Another risk may be antacid medications that alter digestion and may allow increased immune exposure to ingested proteins.(41) Vassallo and Camargo (42) reviewed the mechanisms for the hypothesized link between vitamin D and food allergy.

Recent epidemiologic study findings, such as the observations that season of birth is a risk factor, (43) that food-induced pediatric anaphylaxis is more common in northern areas of the United States,(44) and that maternal intake of vitamin D during pregnancy was associated with a decreased risk of food sensitization,(45) support this hypothesis.

# Summary

Although the exact prevalence and incidence of food allergies remain uncertain, food allergies are common and have sygnificant impact on life quality. Rates of food allergy vary geographically, reflecting various genetic, enviromental and dietary factors.

□

**TABLE 4** Frequency of food allergy among other allergic disorders

| Disorder | Food allergy frequency | Comments |
|---|---|---|
| Atopic dermatitis (AD) | 30-40% of children with moderate to severe persistent AD, not controlled with optimal medical therapy (meticulous skin care and topical anti-inflammatory preparations). (46) Food allergy is uncommon in the adults with AD.(2) | Most common food allergens in children include: milk, egg white, soybean, wheat, peanut, tree nuts, fish. (46) When food is ingested on regular basis, it may be impossible to identify the offending food due to the chronicity of symptoms. However following at least 2 weeks of food elimination, acute symptoms may be seen, including anaphylaxis. (47) Therefore food reintroduction should occur under physician supervision (oral food challenge) |
| Asthma | Several studies have indicated that having food allergy may be a risk for problematic asthma, and having asthma may be a risk for severe/fatal food allergy. (14;38;48) | Frequency of peanut allergy was increased among the children admitted with severe asthma-exacerbations(49) |
| Anaphylaxis | Foods are the most common triggers of anaphylaxis outside the hospital in children and adults. | Serum tryptase is not a reliable marker for food-induced anaphylaxis. Risk factors for fatal food-induced anaphylaxis include: age (adolescents and young adults), delayed use of epinephrine, and co-morbid asthma. |
| Eosinophilic esophagitis (EoE) | Overall, it is estimated that in 50% of subjects with EoE food allergens play a role. | In young children with EoE, response to an elemental diet is >95%.(50;51) |

References: 1. Boyce J, Assa'ad AH, Burks A.W., Jones SM, Sampson HA, Wood RA et al. Guidelines for the Diagnosis and Management of Food Allergy in the United States: Summary of the NIAIDSponsored Expert Panel Report. J Allergy Clin Immunol 2010; 126(6 Suppl):S1-S58. 2. Sicherer SH, Sampson HA. Food allergy: recent advances in pathophysiology and treatment. Annu Rev Med 2009; 60:261-77. 3. Chafen JJ, Newberry SJ, Riedl MA, Bravata DM, Maglione M, Suttorp MJ et al. Diagnosing and managing common food allergies: a systematic review. JAMA 2010; 303(18):1848-56. 4. Nowak-Wegrzyn A, Assa'ad AH, Bahna SL, Bock SA, Sicherer SH, Teuber SS. Work Group report: oral food challenge testing. J Allergy Clin Immunol 2009; 123(6 Suppl):S365-S383. 5. Branum AM, Lukacs SL. Food Allergy Among Children in the United States. Pediatrics 2009. 6. Sicherer SH, Munoz-Furlong A, Godbold JH, Sampson HA. US prevalence of self-reported peanut, tree nut, and sesame allergy: 11-year follow-up. J Allergy Clin Immunol 2010; 125(6):1322-6. 7. Gupta R, Sheikh A, Strachan DP, Anderson HR. Time trends in allergic disorders in the UK. Thorax 2007; 62(1):91-6. 8. Young E, Stoneham MD, Petruckevitch A, Barton J, Rona R. A population study of food intolerance. Lancet 1994; 343(8906):1127-30. 9. Bock SA. Prospective appraisal of complaints of adverse reactions to foods in children during the first 3 years of life. Pediatrics 1987; 79(5):683-8. 10. Liu AH, Jaramillo R, Sicherer SH, Wood RA, Bock SA, Burks AW et al. National prevalence and risk factors for food allergy and relationship to asthma: results from the National Health and Nutrition Examination Survey 2005-2006. J Allergy Clin Immunol 2010; 126(4):798-806. 11. Sampson HA. Utility of food-specific IgE concentrations in prediciting symptomatic food allergy. J Allergy Clin Immunol 2001; 107:891-6. 12. Luccioli S, Ross M, Labiner-Wolfe J, Fein SB. Maternally reported food allergies and other food-related health problems in infants: characteristics and associated factors. Pediatrics 2008; 122 Suppl 2:S105-S112. 13. Sicherer SH, Munoz-Furlong A, Sampson HA. Prevalence of seafood allergy in the United States determined by a random telephone survey. J Allergy Clin Immunol 2004; 114(1):159-65. 14. Liu AH, Jaramillo R, Sicherer SH, Wood RA, Bock SA, Burks AW et al. National prevalence and risk factors for food allergy and relationship to asthma: results from the National Health and Nutrition Examination Survey 2005-2006. J Allergy Clin Immunol 2010; 126(4):798-806. 15. Venter C, Pereira B, Voigt K, Grundy J, Clayton CB, Higgins B et al. Prevalence and cumulative incidence of food hypersensitivity in the first 3 years of life. Allergy 2008; 63(3):354-9. 16. Osterballe M, Mortz CG, Hansen TK, Andersen KE, Bindslev-Jensen C. The prevalence of food hypersensitivity in young adults. Pediatr Allergy Immunol 2009; 20(7):686-92. 17. Burney P, Summers C, Chinn S, Hooper R, van RR, Lidholm J. Prevalence and distribution of sensitization to foods in the European Community Respiratory Health Survey: a EuroPrevall analysis. Allergy 2010; 65(9):1182-8. 18. Kjaer HF, Eller E, Host A, Andersen KE, Bindslev-Jensen C. The prevalence of allergic diseases in an unselected group of 6-year-old children. The DARC birth cohort study. Pediatr Allergy Immunol 2008; 19(8):737-45. 19. Sicherer SH, Sampson HA. Peanut allergy: emerging concepts and approaches for an apparent epidemic. J Allergy Clin Immunol 2007; 120(3):491-503. 20. Ben-Shoshan M, Harrington DW, Soller L, Fragapane J, Joseph L, St PY et al. A population-based study on peanut, tree nut, fish, shellfish, and sesame allergy prevalence in Canada. J Allergy Clin Immunol 2010; 125(6):1327-35. 21. Nicolaou N, Poorafshar M, Murray C, Simpson A, Winell H, Kerry G et al. Allergy or tolerance in children sensitized to peanut: prevalence and differentiation using component-resolved diagnostics. J Allergy Clin Immunol 2010; 125(1):191-7. 22. Shek LP, Cabrera-Morales EA, Soh SE, Gerez I, Ng PZ, Yi FC et al. A population-based questionnaire survey on the prevalence of peanut, tree nut, and shellfish allergy in 2 Asian populations. J Allergy Clin Immunol 2010; 126(2):324-31, 331. 23. Rona RJ, Keil T, Summers C, Gislason D, Zuidmeer L, Sodergren E et al. The prevalence of food allergy: a meta-analysis. J Allergy Clin Immunol 2007; 120(3):638-46. 24. Zuidmeer L, Goldhahn K, Rona RJ, Gislason D, Madsen C, Summers C et al. The prevalence of plant food allergies: a systematic review. J Allergy Clin Immunol 2008; 121(5):1210-8. 25. Hu Y, Chen J, Li H. Comparison of food allergy prevalence among Chinese infants in Chongqing, 2009 versus 1999. Pediatr Int 2010; 52(5):820-4. 26. Chehade M, Sampson HA. Epidemiology and etiology of eosinophilic esophagitis. Gastrointest Endosc Clin N Am 2008; 18(1):33-44. 27. Noel RJ, Putnam PE, Rothenberg ME. Eosinophilic esophagitis. N Engl J Med 2004; 351(9):940-1. 28. Straumann A, Simon HU. Eosinophilic esophagitis: escalating epidemiology? J Allergy Clin Immunol 2005; 115(2):418-9. 29. Straumann A, Spichtin HP, Grize L, Bucher KA, Beglinger C, Simon HU. Natural history of primary eosinophilic esophagitis: a follow-up of 30 adult patients for up to 11.5 years. Gastroenterology 2003; 125(6):1660-9. 30. Simons FE, Sampson HA. Anaphylaxis epidemic: fact or fiction? J Allergy Clin Immunol 2008; 122(6):1166-8. 31. Yocum MW, Butterfield JH, Klein JS, et al. Epidemiology of anaphylaxis in Olmested County: a population-based study. J Allergy Clin Immunol 1999; 104:452-6. 32. Decker WW, Campbell RL, Manivannan V, Luke A, St Sauver JL, Weaver A et al. The etiology and incidence of anaphylaxis in Rochester, Minnesota: a report from the Rochester Epidemiology Project. J Allergy Clin Immunol 2008; 122(6):1161-5. 33. Rudders SA, Banerji A, Vassallo MF, Clark S, Camargo CA, Jr. Trends in pediatric emergency department visits for food-induced anaphylaxis. J Allergy Clin Immunol 2010; 126(2):385-8. 34. Ross MP, Ferguson M, Street D, Klontz K, Schroeder T, Luccioli S. Analysis of food-allergic and anaphylactic events in the National Electronic Injury Surveillance System. J Allergy Clin Immunol 2008; 121(1):166-71. 35. de S, I, Mehr SS, Tey D, Tang ML. Paediatric anaphylaxis: a 5 year retrospective review. Allergy 2008; 63(8):1071-6. 36. Clark S, Espinola J, Rudders SA, Banerji A, Camargo CA, Jr. Frequency of US emergency department visits for food-related acute allergic reactions. J Allergy Clin Immunol 2011; 127(3):682-3. 37. Weiler JM. Anaphylaxis in the general population: A frequent and occasionally fatal disorder that is underrecognized. J Allergy Clin Immunol 1999; 104(2 Pt 1):271-3. 38. Bock SA, Munoz-Furlong A, Sampson HA. Fatalities due to anaphylactic reactions to foods 5. J Allergy Clin Immunol 2001; 107(1):191-3. 39. Pumphrey RS, Gowland MH. Further fatal allergic reactions to food in the United Kingdom, 1999-2006. J Allergy Clin Immunol 2007; 119(4):1018-9. 40. Lack G. Epidemiologic risks for food allergy. J Allergy Clin Immunol 2008; 121(6):1331-6. 41. Untersmayr E, Jensen-Jarolim E. The effect of gastric digestion on food allergy. Curr Opin Allergy Clin Immunol 2006; 6(3):214-9. 42. Vassallo MF, Camargo CA, Jr. Potential mechanisms for the hypothesized link between sunshine, vitamin D, and food allergy in children. J Allergy Clin Immunol 2010; 126(2):217-22. 43. Vassallo MF, Banerji A, Rudders SA, Clark S, Mullins RJ, Camargo CA, Jr. Season of birth and food allergy in children. Ann Allergy Asthma Immunol 2010; 104(4):307-13. 44. Sheehan WJ, Graham D, Ma L, Baxi S, Phipatanakul W. Higher incidence of pediatric anaphylaxis in northern areas of the United States. J Allergy Clin Immunol 2009; 124(4):850-2. 45. Nwaru BI, Ahonen S, Kaila M, Erkkola M, Haapala AM, Kronberg-Kippila C et al. Maternal diet during pregnancy and allergic sensitization in the offspring by 5 yrs of age: a prospective cohort study. Pediatr Allergy Immunol 2010; 21(1 Pt 1):29-37. 46. Eigenmann PA, Sicherer SH, Borkowski TA, Cohen BA, Sampson HA. Prevalence of IgE-mediated food allergy among children with atopic dermatitis. Pediatrics 1998; 101(3):E8. 47. Flinterman AE, Knulst AC, Meijer Y, Bruijnzeel-Koomen CA, Pasmans SG. Acute allergic reactions in children with AEDS after prolonged cow's milk elimination diets. Allergy 2006; 61(3):370-4. 48. Berns SH, Halm EA, Sampson HA, Sicherer SH, Busse PJ, Wisnivesky JP. Food allergy as a risk factor for asthma morbidity in adults. J Asthma 2007; 44(5):377-81. 49. Roberts G, Patel N, Levi-Schaffer F, Habibi P, Lack G. Food allergy as a risk factor for life-threatening asthma in childhood: a case-controlled study. J Allergy Clin Immunol 2003; 112(1):168-74. 50. Kelly KJ, Lazenby AJ, Rowe PC, Yardley JH, Perman JA, Sampson HA. Eosinophilic esophagitis attributed to gastroesophageal reflux: improvement with an amino acid-based formula. Gastroenterology 1995; 109(5):1503-12. 51. Assa'ad AH, Putnam PE, Collins MH, Akers RM, Jameson SC, Kirby CL et al. Pediatric patients with eosinophilic esophagitis: an 8-year follow-up. J Allergy Clin Immunol 2007; 119(3):731-8. 52. Katz Y, Rajuan N, Goldberg MR, Eisenberg E, Heyman E, Cohen A et al. Early exposure to cow's milk protein is protective against IgE-mediated cow's milk protein allergy. J Allergy Clin Immunol 2010; 126(1):77-82. 53. Du TG, Katz Y, Sasieni P, Mesher D, Maleki SJ, Fisher HR et al. Early consumption of peanuts in infancy is associated with a low prevalence of peanut allergy. J Allergy Clin Immunol 2008; 122(5):984-91.

Anna Nowak-Węgrzyn, MD:

1 Gustave L. Levy Place, Box 1198, New York, NY 10029-6574.

Phone: 212-241-5548.

Fax: 212-426-1902.

e-mail: anna.nowak-wegrzyn@mssm.edu

Zamknij Drukuj